National Park Service
Rock Creek Park
Curriculum Based Program

Impacting Our Watershed, A Water Quality Study

After using chemical tests and bioassessment techniques to investigate the quality of water in Rock Creek, students will discuss the impacts people have on the watershed and what changes may help.

Curriculum Based Topics:

Freshwater ecosystems; changes in habitats; chemistry; indicator species;

bioassessment; bioaccumulation

Background Information:

Water is a non-renewable resource. It cycles through our system in the forms of clouds, precipitation, ground water, streams and rivers, oceans, plants and animals. A single drop of water in a water bottle today may have been a drop drunk by dinosaurs, it might have been part of the glaciers at one time, and it could have been in the ocean when Columbus crossed it.

Sometimes it is easy to tell if water is polluted. Strange odors, taste, or color are immediate warning signs. However, most water pollution is undetectable through senses alone. The two best ways to test the quality of water are through bioassessment and chemical tests. Bioassessing a body of water involves finding out what types of organisms, and approximately how many of each live in the water. Some organisms, called indicator species, are less tolerant to pollution than others. There presence, especially in high numbers, are found in good water quality. If they are not present, it may indicate poor water quality. Chemical tests of pH, Dissolved Oxygen, Nitrates, and Turbidity, also reveal much about the health of the water.

Conserving and protecting our water from pollution is vital to us as well as to the environment. Once in the water cycle, pollution can often travel, affecting the entire system. For example pollution can be picked up by rain and carried to a hillside. The pollution will then seep into the ground and soil water or runoff into a stream or lake. Plants soak up the water from the soil, and animals drink it from the streams. The pollution can be transferred in the water.

Audience: Grades 7-12.

Length: 2-3 Hours.

Location: Peirce Barn (2401 Tilden Street, NW) or Peirce Mill

Students per group: maximum of 30

Chaperones per group: 3-5

Curriculum Based, Based on D.C. Science Standards:

Life Sciences

- LS.7 The student will investigate and understand that organisms within an ecosystem are dependent on one another and on nonliving components of the environment. Key concepts include * interactions resulting in a flow of energy and matter throughout the system; * complex relationships in terrestrial, freshwater, and marine ecosystems; and * energy flow in food chains, food webs, and food pyramids.

- LS.8 The student will investigate and understand that interactions exist among members of a population. Key concepts include * competition, cooperation, social hierarchy, territorial imperative; and * influence of behavior on population interactions.

- LS.9 The student will investigate and understand interactions among populations in a biological community. Key concepts include * the relationship among producers, consumers, and decomposers in food chains and food webs; * the relationship of predators and prey; * competition and cooperation; * symbiotic relationships and niches; and * the role of parasites and their hosts.

- LS.10 The student will investigate and understand how organisms adapt to biotic and abiotic factors in a biome. Key concepts include * differences between ecosystems and biomes; * characteristics of land, marine, and freshwater biomes; and * adaptations that enable organisms to survive within a specific biome.

- LS.11 The student will investigate and understand that ecosystems, communities, populations, and organisms are dynamic and change over time (daily, seasonal, and long term). Key concepts include * phototropism, hibernation, and dormancy; * factors that increase or decrease population size; and * eutrophication, climate change, and catastrophic disturbances.

- LS.12 The student will investigate and understand the relationships between ecosystem dynamics and human activity. Key concepts include * food production and harvest; * change in habitat size, quality, and structure; * change in species competition; * population disturbances and factors that threaten and enhance species survival; and * environmental issues (water supply, air quality, energy production, and waste management).

- LS.10.8 The student will identify natural hazards, describe their characteristics, explain their impact on human and physical systems, and assess efforts to manage their consequences in developed and less developed regions.

- LS.10.10 The student will analyze the patterns of urban development, in terms of site and situation, the function of towns and cities, and problems related to human mobility, social structure, and the environment.

Goals: The program will;

1. Explain how chemicals and bioassessment determine water quality.

2. Discuss the life cycle of several aquatic animals.

3. Explain the importance of maintaining clean water.

Objectives: By the end of the program, students will be able to;

1. Explain how either pH, nitrates, or dissolved oxygen affects wildlife in the creek.

2. Give one reason good water quality is important.

3. Identify three animals that live at least part of their lives in water.

Safety and Resource Management Message:
1. Please do not harm, harass, or remove any native plants, animals, or historic artifacts from the park.

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Pre-visit Activities:

1) Water Sample Activity

1. Fill an aquarium with 5 gallons of water, or bring in five-gallon jugs of water. This represents the total amount of water in our ecosystem, the Earth.

2. Remove 2.25 cups of water. This is the total supply of freshwater on Earth. Pour into container #1. Ask group what kind of water is left in the aquarium. (salt water)

3. Take 1.75 cups of water from container #1 and places it in container #2. This represents the water locked up in polar ice caps, glaciers, topsoil, and suspended in the atmosphere.

4. There is 0.5 cups of water left in container #1. Remove half (.025 cups). This water represents the water that is either inaccessible or polluted. The remaining five drops or so represent the fresh water supply that is available and useable to people.

5. What does this tell you about how we should use our water resources? Ask the group how they can use water more wisely. How can they conserve water?

2) I Need Water

1. Ask the students to estimate how much water they use in a day.

2. At the start of class, put a bucket beneath a faucet and allow it to drip slightly. At the end of class check it to see how much water a leaking faucet can waste.

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Post-visit Activities:

1) How Do You Measure Up?

1. Ask each student to complete the attached questionnaire "How Do You Measure Up?"

2. Each student will compare their Total Score to the back to find out how he or she measured up.

3. Use the students' scores to find the high, low, average and median score of the class.

4. Discuss some of the ways students can help lower their total water use.

2) Take the Litmus Test!

With a simple test you can discover what acids you use everyday.

Main Activity
Using a special kind of paper called litmus paper, you will test some common solutions. Litmus or pH paper is an indicator paper that turns different colors depending how acidic or basic a solution is.

Materials
- Measuring cups
- Water
- 4 glasses or jars
- Lemon juice
- Ammonia
- Baking Soda
- Cola soft drink
- Litmus paper

1. Put 250 ml of water in each glass or jar. Label the jars A, B, C and D.

2. Add 10 ml of lemon juice in A; 10 ml of ammonia in B; one gram of baking soda to C, and 10 ml of cola to D.

3. Dip a separate piece of litmus paper into each container. Compare your results to the color chart included with your litmus paper.

Questions

1. Were you surprised by the pH level of the cola? What about the ammonia?

2. Can you name other acidic solutions? What about base or alkali solutions?

3. What happens if you mix an acid and a base together? What does the litmus paper look like?

Other Activity Ideas:

1) Compare the ingredients on the labels of various antacids. Do they have any common ingredients? Are these products acids or bases? When do you use these products? What other acids and bases are found in medicine?

2) Put a piece of chalk into a jar of vinegar. Observe what happens to the chalk. Put a piece of limestone into another jar of vinegar. What happens to the liquid? Are any gasses being released? Could acid rain have the same effect on buildings and roadways?

3) Watch the newspapers for two weeks and clip out any articles on air, water or land pollution. What are people doing about these environmental problems? If this is a global issue, how can everyone work together to help the environment? What can you do?

4) Choose three of the same size and type of plant for an experiment. Make sure that they are in the same size pots and have equal amounts of sunshine and liquid. Over a one to two week period, water plant A with just water, plant B with water and lemon juice and plant C with water and baking soda. Record your observations. Which plant looks the healthiest? Is there any damage to the plant that received baking soda?

3) Making a Water Sampler
This lesson developed by Reach Out!

Materials

Each water sampler requires:

1. 1/2 gallon plastic milk jug or bleach container

2. Rubber stopper or cork

3. Eyebolt, nut and 2 washers

4. 1/8 inch diameter rope

5. Twine

6. Brick

7. Drill

8. Scissors

9. Magnifiying glass, microscope

Room Preparation: Need space to assemble water sampler

Safety Precautions: Suggest an adult drill holes through rubber stoppers or corks

Activity

Individuals or partners make a water sampler.

1. Put an eyebolt, with a washer on top, through the rubber stopper or cork.

2. Tighten the eyebolt with the nut and washer on the bottom.

3. Tie a brick to the handle of the jug with heavy rope to lower and anchor the jug in water.

4. Tie the stopper or cork to the handles of the jug with twine (give a little slack). Allow enough twine for the jug to be lowered to the depth of water to be sampled.

5. Place stopper or cork firmly in jug.

6. To use, lower the twine to the desired depth. Jerk to remove the stopper or cork from the jug.

7. Let jug fill up with water.

8. Bring up jug.

9. Observe what you have with your eyes, magnifying glass, and microscope.

Additional Activity

Plan an outing to use water samplers. Collect water and put rubber stopper or cork back in jug to contain water. Have students observe using just their eyes, using a magnifying glass, and then samples of water under a microscope.

Cool Facts About Water

HOW MUCH WATER IS THERE? - APPROX. 326,000,000 cubic miles

Of this, the ocean has 317,000,000 " "

Leaving 9,000,000 " "

Of this, icecaps and glaciers have 7,000,000 " "

Leaving 2,000,000 " "

Of this, the subsurface groundwater 2,000,000 " "

Leaving 0???

Since the above numbers were rounded, the numbers that follow are almost infinitely insignificant. Yet on them, our lives depend:

Freshwater lakes have 30,000 cubic miles

Saline lakes and inland seas have 25,000 " "

Soil moisture has 16,000 " "

The atmosphere has 3,100 " "

And rivers and streams have only 300 " "

A single drop of water contains 1,700,000,000,000,000,000 (1.7 quintillion) molecules

One mathematician has calculated that if Columbus spilled a glass of water into the sea back in 1492- and if that glass of water was by now thoroughly mixed in all the oceans and rivers of the world, then "every glass of water drawn from every faucet in the world would contain as many as 250 molecules from the original water Columbus had spilled from his glass."